Hearing Aid (Appendix "A" Beginning of Description PCT/CH 98/00502)

This invention concerns a hearing aid according to the preamble to Claim 1 and a process for producing a hearing aid according to the preamble to Claim 9.

Hearing aids are extremely complex systems. To meet the needs of the consumer, it is necessary to provide a large number of variations of different hardware configurations. This involves an extremely cost-effective [sic] variety for the manufacture, sale and adjustment of hearing aids, because a large number of different configurations must be set up in manufacturing, named and tested accordingly, storage is necessary for them in sales and other procedures must be selected to adjust them to the individual needs of the buyer, depending on the existing configuration of the device.

The task of the invention is to solve this problem starting with the type of hearing aid mentioned at the beginning. For this purpose, at least some of the peripheral units are provided with an identification unit, whose output has a working connection to the input of a comparison unit. With the comparison unit, there is also a potential identification storage unit with a working connection on the input side. The comparison unit works on a configuration storage unit on the output side.

Because at least some, and preferably all peripheral units, identify themselves, and the comparison unit stores the existing hardware configuration according to the identification reported by the peripheral units, after comparing it with several possibilities for connecting peripheral units, this has the following major advantages:

Once assembled, the hearing aid identifies itself by determining via the comparative unit what its configuration is in terms of peripheral units.

The self-identification, with no inscription necessary like for example on the package,

obviates the possibilities of problems during the production controls, sale and adjustment of the hearing aids, because it rules out testing, delivering or adjusting an existing hearing aid on the basis of a supposed other configuration, as far as the peripheral units are concerned.

In one preferred form of embodiment, the output of the comparison unit is connected to an operation selection input on the signal-processing unit. This only allows processing on the signal-processing unit, whether for the operation itself or for implementation, which are also allowed with the actual existing system constellation. Operating programs that should be implemented wirelessly via a transceiver, for example, can be tested for reliability in terms of the prevailing system constellation.

In another preferred form of embodiment of the hearing aid in the invention, the working connection between the peripheral units and the central signal-processing unit is made via a bus and interface units. It is obvious that in a conventional hearing aid, the central digital signal-processing unit must be connected to the peripheral units by the hardware The more options in terms of the peripheral unit that are provided, the more connections must be provided for the central signal-processing unit. This number increasingly dominates the chip surface necessary for the signal-processing unit mentioned, which is a big disadvantage in terms of the miniaturization sought in the hearing aid sector. The fact that the working connection mentioned is made with a bus and interfaces means that a minimum number of hardware connections can be provided, which are used up, depending on the hardware configuration identified, which identifies and interprets the signals applied to it by the configuration-specific signal-processing unit. The peripheral units that can be used include, inter alia, microphones, etc. generally sensors, loudspeakers, etc., generally actuators, and transceivers, i.e., wireless transmitters and/or receivers, manual select units, loud-speaker controllers (potentiometers), read-only memories, for example with processing parameters for the signal-processing unit, read/write memories, for example for logging the processing, etc.

These peripheral units can be largely broken down into audio-signal components, for

example sensors, actuators, amplifiers, filters, etc., and control components, for example transceivers, selector switches, memories, etc.

Preferably, a first bus with first interface units is used for the first, and a second with second interface units for the latter. The first interface units are, again preferably, built on the basis of at least three-wire interface units, and the second on the basis of at least two-wire interface units. I^1S are suitable for this as three-wire interface units and I^2C as two-wire interface units, both sold by Philips.

But basically the signal-processing unit/bus/peripheral units connection can also be made with other interface units, for example with AES-3 interface units from Audio Engineering Society and/or SPI interface units from Motorola.

The ACTUAL configuration also determines which signals will be transmitted to the central signal-processing unit and therefore which control parameters. If the hearing aid in the invention automatically identifies the peripheral units, this also makes it possible automatically to activate, from a large number of potential signal-processing configurations, the prevailing configuration of the peripheral units, or for example to implement it externally, for example via a transceiver, i.e., wirelessly. This also eliminates the problem of implementing signal-processing processes on a hearing aid that do not at all correspond to the existing configuration of the peripheral units.

In another preferred form of embodiment, the hearing aid in the invention has an output which has a working connection with the configuration storage unit on the hearing aid. This makes it possible, by connecting the hearing aid to a computer-aided adjustment device, to have the hearing aid log on to that device and identify itself with its existing configuration and eliminate adjustment errors due to false assumptions about the hearing-aid configuration. This communication can also be wireless, by having the output mentioned composed of a transceiver.

The inventive process for producing a hearing aid is described by the wording in the characterizing part of Claim 10. Other preferred embodiments of the production process in the invention are specified in the other claims.

The invention will next be explained giving examples using the figures.

Figure 1 shows the basic principle of the hearing aid in the invention using a signal flow/function flow chart,

Figure 2 shows one preferred design concept for the hearing aid in the invention,

Figure 3 shows one preferred form of embodiment of the hearing aid in the invention, according to the concept in Figure 2.

In Figure 1, the hearing aid in the invention includes a central digital signal-processing unit 1 with signal inputs E and signal outputs A. Peripheral units 3_E and 3_A have a working connection to signal inputs E and signal outputs A. Peripheral units 3_E can be, for example, sensors, for example microphones, general acoustic/electric converters, or control components, for example a remote control with transceiver, program switching units, a loud-speaker adjustment unit, etc. Peripheral unit 3_A can be especially actuators, like one or more electrical/mechanical or electrical/electrical output converter units.

In Figure 1, at least one peripheral unit 3_E is provided on the input side and at least one 3_A on the output side of the signal-processing unit 1. Digital and/or analog inputs with analog/digital converters connected after them (not shown) are provided on the central signal-processing unit 1 and correspond to the signals given by peripheral units 3_E. In the same way, on the output side of unit 1, depending on the signals processed by the peripheral units 3_A, digital outputs and/or analog outputs with digital/analog converters connected before them are provided.

Each of the at least two peripheral units 3 provided has an identification memory 5. The information filed in the identification memories 5 is highly specific to the type of peripheral unit considered, hence microphone-type, remote-control type, etc., for example.

An identification cycle is triggered according to the hardware configuration of the hearing aid. In it, as shown schematically with cycle unit 7, all identification memories 5 provided are read out, for example sequentially, and if necessary, it is determined that no units are connected to the empty connections 5. The contents of the memory of the identification memory 5 are fed to a comparison unit 9 via unit 7. In a read-only memory unit 11, all peripheral units possible for the signal-processing unit 1 provided are marked with their accompanying identification marks.

To make sure that the signal-processing unit 1 provided and the read-only memory 11 are also coordinated with one another – in the sense that, in memory 11 the actual identification marks of the peripheral units are pre-stored that go with the respective signal-processing unit 1 – an identification mark filed in an identification memory 52 of the signal-processing unit 1 can be compared, using unit 7 and comparative unit 9, with the contents filed in the read-only memory 11 in identification memory 5_{11} that identifies that memory or its contents.

After that, as shown schematically with switching unit 13, the comparison unit 9 uses the marks in the identification memories 5 to determine sequentially which kinds or types of peripheral units 3 prestored in the read-only memory 11 are in the existing device configuration and which are not. If a type-X signal-processing unit 1 and types M and N peripheral units are provided, then on the output side of the comparison unit in a hearing aid configuration memory 15, the device configuration will be stored with X, M, N, whereby other peripheral units type A, S, etc. would be compatible with the type X signal-processing unit 1 provided, as shown in the read-only memory 11.

On the output side, the configuration memory 15 works on the signal-processing unit 1. Using the existing hardware configuration, as shown with the switching unit 17 in Figure 1, a

specific working mode is activated or enabled on the signal-processing unit, according to S_{MW}. If the working mode is not even loaded yet in terms of software in the signal-processing unit 1, based on the configuration identified in the configuration memory 15, the loading of working modes, in the form of software, that do not fit the machine hardware configuration provided can be blocked. If, as shown schematically in Figure 1, a transceiver 30 is provided, by which the signal-processing unit 1 is implemented wirelessly with the desired processing program, then, as shown schematically on the switching unit 17a, implementation via transceiver 30 is prevented if an attempt is made to process that does not correspond to configuration X, M, N.

The output of the configuration memory unit 15 preferably runs on an output HG_A of the hearing aid. When the hearing aid is adjusted, this output is put on the computer-aided adjustment unit 19, and the individual configuration of the hearing aid is identified on the adjustment unit 19. With it (shown in dashes), in one preferred form of embodiment, the output described HG_A can be put on the transceiver (HG_A). Providing a transceiver 30 is basically highly advantageous, and necessary for binaural signal processing. With it, the two signal-processing units 1 can communicate with one another or, preferably, binaural signal-processing can be done on one common unit 1.

In another preferred form of embodiment in Figure 2, communication is created between the central digital signal-processing unit 1 and peripheral units 3, and then with the read-only memory 11, for example an EEPROM and, to adjust the device, with an external adjustment device, basically via a bus arrangement 21, as well as via interfaces to the units mentioned. Preferably standard interfaces are used as an interface unit (not shown), preferably simple interface units, especially with only two or three-signal lines like, for example and preferably, I^2c, I^2s interfaces, as they are currently sold by Philips or AES-3 interfaces (Audio Engineering Society) and SPI interfaces (Motorola).

As shown also in Figure 2, if necessary, there is at least partly a two-way communications link between the peripheral units 3 and the central signal-processing unit 1 via a bus arrangement

21, whereby, along with the component identification explained with Fig. 1, other specific variables, like other configuration parameters, operation option data and/or revision data can be transmitted from the peripheral units to the central signal-processing unit, and data can be retransmitted from the central signal-processing unit 1 to the peripheral units. Preferably, as shown in Fig. 2, the central signal-processing unit 1 includes a signal-processing part 1, as well as a controller part 1_S, which controls and monitors the configuration identification via bus arrangement 21.

Figure 3 shows one preferred form of embodiment of the principle explained, using Figure 2. The peripheral units here are basically divided into audio signal units or components 3_{AV} and control units or control components 3_S, and depending on the type present, are treated as audio signal components or control components in pure form or in a hybrid constellation. Audio components 3_{AV} are connected via a first bus 21_{AV} and corresponding interface units (not shown) to the signal-processing part 1a of the signal-processing unit 1, while control components 3_S are connected via a second bus 21_S to the control part 1b of signal-processing unit 1, in turn over corresponding interfaces. To establish the connection between audio components 3_{AV}, bus 21_{AV} and signal-processing part 1a, preferably differently specified interface units are used than for the connection between control components 3_S, bus 21_S and controller part 1b.

Three-wire interface units are preferably used for the connections mentioned, preferably based on the I^2S-type interface units already mentioned.
For the second connection mentioned, i.e., the actual control connection, preferably two-wire interface units are used, especially the I^2c-based type of interface units already mentioned.

Hybrid peripheral units that are involved in audio-signal processing and controlled or vice versa, as shown in dashes, with the corresponding preferred audio-connection interfaces or control connection interfaces are also connected to the second bus provided.

The hearing aid in the invention provides an actual "plug and play" modular system for

hearing aids, which makes it possible to cut manufacturing costs drastically, to minimize the connection configuration on the central signal-processing unit and especially to rule out largely faulty packing, faulty configurations, maladjustments, etc. based on human carelessness.

Patent Claims: (Appendix "A" to PCT/CH 98/00502)

1. A hearing aid with a central digital signal-processing unit (1), which has a working connection on the input and output sides to digital, hybrid and/or analog peripheral units (3E, 3A), characterized by the fact that at least some of the peripheral units have one identification unit (5) each, whose output has a working connection to the input of a comparison unit (9), and the comparison unit is connected on the input side to an identification-possibilities storage unit (11) and works with a configuration storage unit (15) on the output side.

2. The hearing aid in Claim 1, characterized by the fact that the output of the comparison unit (9) has a working connection with an operation selection input (17) on the signal-processing unit (1).

3. The hearing aid in Claim 1 or 2, characterized by the fact that the working connection between the peripheral units and the central signal-processing unit is established via at least one bus and via interface units.

4. The hearing aid in one of Claims 1 to 3, characterized by the fact that one output (HG_A, HG'_A) is provided on the hearing aid that has a working connection to the configuration storage unit (15).

5. The hearing aid in Claim 3, characterized by the fact that the interface units include three-wire interface units and/or two-wire interface units.

6. The hearing aid in Claim 3, characterized by the fact that the audio-signal components have a working connection to the signal-processing unit, as peripheral units, via a first bus and first interface units, and the control components, as peripheral units, via a second bus and second interface units, whereby preferably the first interface units are at least three-wire interfaces, and the second at least two-wire interfaces, and the first are preferably I^2S-based and the second

preferably I^2C-based interfaces.

7. The hearing aid in one of Claims 1 to 6, characterized by the fact that the peripheral units include one or more of the following units: sensors, actuators, transceivers, manual selection units and potentiometers.

8. The hearing aid in Claim 4, characterized by the fact that the output is composed of a transceiver.

9. A process for producing a hearing aid with a central, digital signal-processing unit and peripheral units connected to it, characterized by the fact that the peripheral units are built into the central, digital signal-processing unit, and then the identities of the peripheral units are automatically queried and stored.

10. The process in Claim 9, characterized by the fact that with the queried identities of the peripheral units, the operation of the signal-processing unit is selected, and preferably the implementation of any operation foreign to the peripheral units provided is blocked.

11. The process in one of Claims 9 or 10, characterized by the fact that, based on the identification, signals on connections to and/or from the digital signal-processing unit are interpreted differently.

Abstract

(End of Appendix "A" of Description PCT/CH 98/00502)

A hearing aid is proposed with a central signal-processing unit (1). It has working connections to peripheral units (3E, 3A) on the input and output sides. The peripheral units each have an identification unit (5), whose output is connected to the input of a comparison unit (9). The comparison unit is, in turn, connected to means of identification – storage units (11), and on the output side it works with a configuration storage unit (15). With it, the hearing aid configuration identifies itself with the peripheral units.